

Definition 0.1. A [category](#) $\mathcal{R}_M$ whose [objects](#) are all [Riemannian manifolds](#) R and whose [morphisms](#) are [mappings](#) between Riemannian manifolds m_R is defined as the *category of Riemannian manifolds*.

0.1 Applications of Riemannian manifolds in mathematical physics

1. The *conformal Riemannian subcategory* $\mathcal{R}_C$ of $\mathcal{R}_M$, whose objects are Riemannian manifolds R , and whose morphisms are conformal mappings of Riemannian manifolds c_R , is an important category for mathematical physics, in [conformal theories](#).
2. It can be shown that, if (R_1, g) and (R_2, h) are Riemannian manifolds, then a map $f: R_1 \rightarrow R_2$ is [conformal](#) *iff* $f^*h = s.g$ for some [scalar field](#) s (on R_1), where f^* is the [complex conjugate](#) of f .

0.1.1 Category of pseudo-Riemannian manifolds

The category of [pseudo-Riemannian manifolds](#) $\mathcal{R}_P$ that generalize [Minkowski spaces](#) M_k is similarly defined by replacing the Riemannian [manifolds](#) R in the above definition with [pseudo-Riemannian manifolds](#) R_P . Pseudo-Riemannian manifolds R_P s were claimed to have [applications](#) in Einstein's theory of general relativity (GR), whereas the [subcategory](#) **Mink** of four-dimensional Minkowski spaces in $\mathcal{R}_P$ plays the [central](#) role in special relativity (SR) theories.